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Modeling the efficiency of the agri-environmental payments to Czech agriculture in a CGE framework incorporating public goods approach

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Abstract

Capturing agricultural multifunctionality challenges agricultural economists for more than a decade. On one hand, researchers increasingly build in their commodity based models provision of environmental protection and landscape maintenance, on the other hand, there are efforts as contingence valuation to assess the economic value of environmental benefits provided by agriculture. This paper and the corresponding research tries to merge the both research streams by incorporating supply and demand of landscape public good in the CGE framework. The former is done by including an explicit sector of joint commodity and non-commodity production in the model structure, the latter by extending the household demand system of willingness to pay for landscape. The approach is tested on four scenarios which are extensively compared.

Keywords: Environmental public goods, agri-environmental policy, CGE models

JEL classification: Q11, Q15, Q18

1. INTRODUCTION

Capturing agricultural multifunctionality challenges agricultural economists for more than a decade. This is, of course, associated with the turn of agricultural policy from market intervention to the support to provision of public goods as environmental conservation; i.e. the turn from the support to commodities to the support to non-commodities. On one hand, researchers increasingly build in their commodity based models provision of environmental protection and landscape maintenance, on the other hand, there are efforts to assess the value of environmental benefits provided by agriculture. Concerning the former, most of the EU-based research has tended to addresses multifunctionality by integrating bio-physical, land use and economic models, such as works of Uthes, Ittersum and Sieber (2010), Renting, Rossing and Ittersum (2009), Rossing, Zander and Josiem (2009), Parra-Lopez, Groot, Torres et al. (2009). Using either single or integrated model approaches, partial or general equilibrium models, the research concentrates almost exclusively on the cost of public good provision omitting completely the economic value of the benefit. This unfortunately leaves cost benefit sides unbalanced and supports the view that agriculture is a pure consumer of taxpayer money.

This paper and the corresponding research are motivated by overcoming this problem by linking the both research streams together. The research particularly draws on the works of Cretegny (2002), and Rødseth (2008), aiming at Swiss and Norwegian agriculture respectively, who conceptualised supply and demand of landscape public good in the CGE framework.

The objective of the paper is to assess the efficiency of the agri-environmental (AE) payments directed to permanent grasslands (meadows and pastures), which maintenance is a key element of cultural landscape conservation. This objective has been translated in three research questions: i) what landscape provision would correspond to actual WTP of households and what will be the "socially optimal" subsidy rate, ii) what is the value of "landscape" provided by farmers and iii) what would be the effect of removing a certain proportion of AE payments since 2014.

The paper is structured as follows: the CGE model and the methodology of including in it supply and demand of environmental public goods is outlined in the next section, simulation scenarios are described in Chapter 3 and the results in Chapter 4; we discuss the outcomes of the exercise and draw conclusion in Chapter 5.

2. METHODOLOGY

In order to assess the efficiency of the agri-environmental policy, a Computable General Equilibrium (CGE) model has been applied. The choice of this approach is supported by various arguments. According to Piermartini (2006), the general equilibrium models (CGE models) provide a consistent, rigorous and quantitative way of assessing economic policies and they serve as supporting tools in the decision making process. Decreaux and Valin (2007) further emphasize, that the CGE models are based on robust and generally accepted behavioral patterns of the economic agents. Concerning the area of public goods modelling, the CGE models are capable of internalizing public goods into markets by capturing their jointness with commodity production and by incorporating them into the consumption pattern of households or government (Rødseth, 2008).

At the very beginning of the research we assumed to utilize the survey on Czech citizens willingness to pay (WTP) for agricultural public goods (landscape) conducted by UZEI in 2009 (Majerova, Wollmutova, Prazan, 2009). However, in the course of the work it became apparent, that the survey was more sociologically oriented and thus that it lacked a clear reference to the extent of public good in terms of what landscape area and what landscape features it covered. Therefore, the survey could only provide indicative information which had to be completed from literature or by consulting experts.

The exercise has been restricted to only public good (landscape) stemming from extensive beef production on permanent grasslands. Actually, the measure "Support to the Maintenance of Grasslands" is far the largest AEM, and grasslands are further supported by the measure "Support to Ecological Farming" (see MA, 2007). Concentrating to only one agricultural sub-sector enables us to incorporate the jointness of production between a concrete commodity and environmental non-commodity and to capture the competition for land between extensive and intensive farming.

2.1. Description of the CGE model for the Czech Republic

The presented CGE model has been developed for the economy of the Czech Republic with a specific focus on the agricultural policy simulations. The national economy is modelled in a disaggregation into 13 production sectors; of which 8 represent specific agricultural sectors and the other represent the sectors of industry and services (Table 1).

The production side of the economy is modelled following a standard CGE model structure (see Lofgren, 2002). It is assumed, that the total gross production is a fixed factor Leontief combination of intermediate consumption and value added under perfect competition and constant returns to scale, which can be expressed by a nested production structure (for the schematic production structure as well as for more details on the model description see Křístková, 2010 b).

Table 1: Production sectors in the CGE model

Sector	Land employment	Description
sec1	*Secland*	Cereals
sec2		fruits and vegetables
sec3		Oilseeds
sec4		sugar beet
sec5		Cattle
sec6		pigs and poultry
sec7		Milk
sec8		other agriculture
sec9	*Secnland*	forestry and fishing
sec10		food industry
sec11		other industry
sec12		R&D
sec13		other services

Two groups of production sectors are distinguished in modelling of value added: sectors that use land as a production factor (secland) and sectors that use only labour and capital (secnland). In the first stage, value added is formed by the combination of labour (L_i) and capital-land bundle (KD_i) based on the CES I production function (equation 1):

$$\text{CES I: } VA_i = aF_i \cdot \left(\chi F_i \cdot KD_i^{-\rho Fi} + (1-\chi F_i)\cdot L^{-\rho Fi}\right)^{-1/\rho Fi} \qquad (1)$$

where aF_i is the efficiency coefficient and χF_i a (1- χF_i) are the distribution parameters of the production function. Parameter ρF_i in the exponent is derived from the elasticity of substitution σF_i between the production factors KD_i and L_i.

Analogically in the second stage, the optimal combination of capital (K_i) and land (D_i)is modelled with the use of the CES II production function (Equation 2):

$$\text{CES II: } KD_i = aG_i \cdot \left(\chi G_i \cdot K_i^{-\rho Gi} + (1-\chi G_i)\cdot D^{-\rho Gi}\right)^{-1/\rho Gi} \qquad (2)$$

The production structure further includes the depreciation of capital, which is modelled as a fixed proportion from the current level of capital stock.

Two households are considered – agricultural households and other households. Whereas the microeconomic theory provides numerous suggestions, the standard Stone-Geary Linear Expenditure System (LES) has been chosen for modelling households behaviour (Equation 3).

$$U = \prod_j \left(C_j - \mu H_j\right)^{\alpha HLESj}, \sum_j \alpha HLES_j = 1 \tag{3}$$

where U is the consumer's utility, C_j is the amount of consumption of the j-th commodity, μH_j represents the subsistence level of consumption of each j-th commodity and $\alpha HLES_j$ is a preferential parameter of the respective j-th commodity in the consumer basket.

The households' consumption budget is determined by the net value of its income after taxation and transfers, reduced by its savings.

The government maximizes utility modelled by the Cobb-Douglas utility function subject to the disposable budget which is derived from incomes received on basis of tax collections:

$$U = \prod_j CG_j^{\alpha CG_j} \quad \text{, where } \sum_j \alpha CG_j = 1 \tag{4}$$

Where CG_j is government consumption of a commodity j and αCG_j represents a preferential parameter in the government´ s consumption basket.

The closure of the governmental account is arranged by fixing a ratio of governmental consumption to GDP. Governmental savings are thus adjusted to the difference between governmental incomes and expenditures.

Total supply in the market is represented by a composite commodity consisting of the bundle of domestically produced goods supplied to domestic markets and imports. The composite commodity is a result of two simultaneous forces in the model, first the intention of producer to find the most profitable combination of supply between foreign and domestic markets, modelled with a Constant Elasticity of Transformation (CET) function, and the intension of the consumer to find an optimal combination of imported and domestically produced commodity, modelled with a CES Armington function. Two non-domestic institutions are assumed the EU and the Rest of the World (RoW).

The model considers six closure and factor market assumptions: i) supply of labour and land is fixed; capital stock grows at the rate of net investments; ii) capital is fully employed in all sectors, whereas land is employed only in agriculture; iii) labour unemployed is allowed and determined by the Phillips curve; iv) the model follows a standard macroeconomic balance of savings and investment; v) export and import prices are fixed; vi) both foreign sector closures (for the EU and the RoW) assume fixed foreign savings and endogenously adjusting exchange rates.

The CGE model follows a recursive form of dynamization with a Tobin's Q investment function, which allocates investments to the sectors according to their ratio of profitability to the user costs (for a detailed description, see Křístková, 2010 a).

It is worth to mention one peculiarity concerning the implementation of policies. Due to the fact that the direct payment rate per hectare highly exceeds the land rent in the Czech Republic, modelling direct payments solely as land subsidies is not possible (see also Gohin, 2006). In order to eliminate this problem, only a part of the direct payments is allocated to land and the rest is modelled as a production subsidy.

2.2. The Social Accounting Matrix and exogenous variables

The model Social Accounting Matrix (SAM) is based on National Accounts data published by the Czech Statistical Office for the year 2006 (CSO, 2010a). Given the need to conduct agricultural policy analyses and simulations the agricultural production and commodity accounts have been disaggregated in 8 sub-sectors/commodities on basis of commodity balance calculations and cost survey tables provided by the Institute of Agricultural Economics and Information (UZEI). From the same analytical reasons, the agricultural households are separated from the other households. This split in two household accounts is based on the Statistics of Household Accounts (CSO, 2010b).

The expected growth rates of the exogenous variables were taken from various official sources: the prediction of GDP EU is based on the Economic Forecasts of the European Commission (EC 2010); world prices and world GDP are taken from the IMF predictions (IMF, 2010); and the growth rates of the domestic exogenous variables, such as transfers or the GDP deflator, are taken from the Czech Ministry of Finance (MF 2010).

2.3. Incorporation of public goods into the CGE model

Supply of grassland linked landscape

As it has been already mentioned the extensive livestock farming sector is added to the SAM. It is assumed that this sector produces jointly a private commodity – beef meat and a public commodity –cultural landscape. The total domestic production of beef thus consists of the production of intensive livestock farming (sector 5 in the CGE model) and of extensive farming (sector 14 in the CGE model). It is assumed that there is no qualitative difference between the two beef commodities.

Following Cretegny (2002), public good is modelled in a joint production function with a market commodity. A linear form of the joint-production function was chosen, where the area of extensive grasslands is the quantity of public good and value of the beef production with the concentration of 0.3 LU/ha is the private good. In this case, the linear function is preferred against the CES production function used in the other production sectors, as it impedes substitution between land and capital, which is characteristic for extensive farming. Scheme 1 shows the nested production structure used in the CGE model including extensive livestock.

As for the other agricultural sectors, the cost survey carried out by UZEI is utilised for the specification of the extensive livestock sector in the SAM.

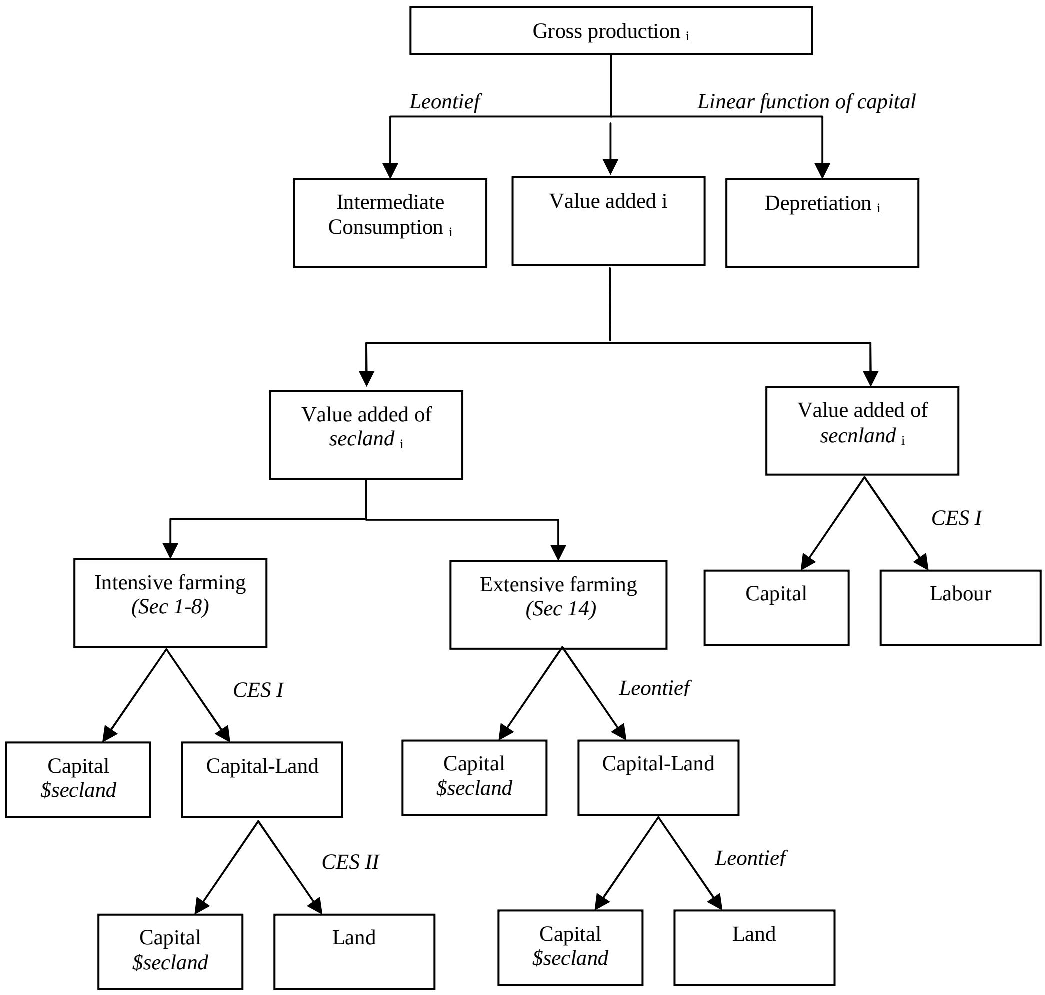
Table 2 demonstrates the differences between the cost structure of the extensive livestock sector and the intensive one. It is obvious that the extensive livestock sector must get additional revenue if it is to survive, since the production costs highly exceed market revenues.

Table 2: Cost structure of intensive and extensive livestock farming (2006) in mln. CZK

	Intensive livestock (sec5)	Extensive livestock (sec14)
Intermediate Consumption	4688	2099
Labour	1 861	403
Capital	265	199
Land	73	889
Total subsidies	-2 009	-2 477
Gross Capital Depreciation	302	182
Gross-gross production	*5 180*	*1 295*

Source: UZEI

Scheme 1: Nested production structure in the CGE model



Source: own illustration

Demand for public goods

The last comment on costs of extensive beef production means in turn that public good associated with extensive livestock production on grasslands will be under-supplied under market conditions. This situation is also depicted in Figure 1, the area of grasslands is marked as L_m.

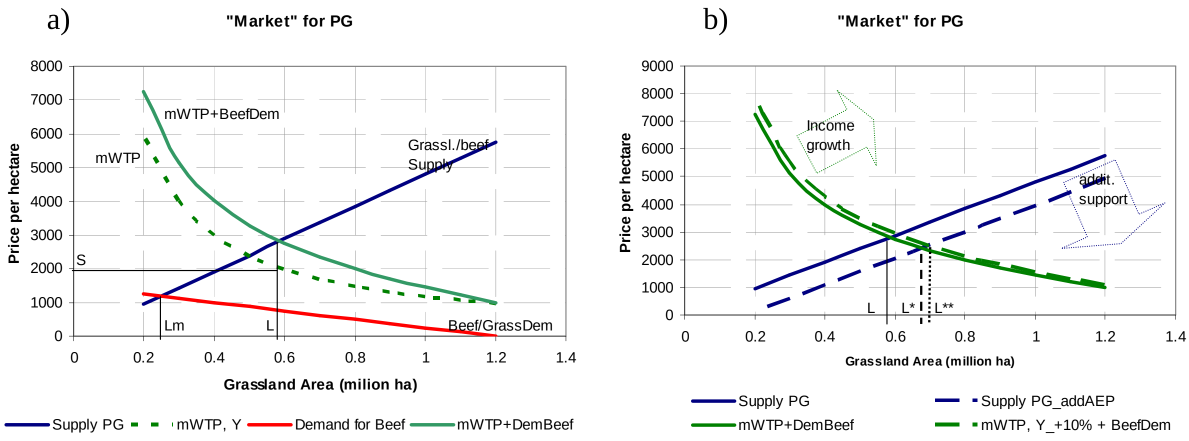
In absence of the market for public goods it is government who can purchase socially demanded amount of grasslands landscape. Actually, the government provides funds to subsidise extensive livestock production on grasslands. Figure 1 a) illustrates that the socially optimal supply of grasslands (L) is given by the intersection of the joint beef and public good demand curve with grasslands-beef supply curve (marginal cost of pastoral beef production per hectare of grasslands). The corresponding optimal subsidy rate (payment per hectare - S) equals marginal WTP (mWTP) at the point L (see also Rødseth (2008)).

Figure 1b) shows what happens with the optimal provision of grasslands landscape if household income grows and/or there are additional subsidies paid to extensive beef farmers.

Following this the Czech CGE model was extended by assuming that the public good (landscape) produced by the extensive livestock farming sector is consumed directly by households. Therefore, landscape is incorporated into the Linear Expenditure System of both types of households. In order to maintain the original benchmark equilibrium, the consumption of landscape is introduced in the SAM by separating it from demand for services.

Although the original intention was to use the results of UZEI’s contingent valuation of landscape, for reasons stated earlier, we finally determined the parameters of mWTP (represented in the LES form) by assuming that the provision of grassland landscape (area of grasslands) was at its optimum in 2006 and that income elasticity of WTP equals 1.2. These are strong assumptions which are only weakly supported by the evidence - no other valuation of landscape has been conducted in the Czech Republic recently.

Figure 1. Market for public goods (grassland – landscape)



Source: own illustration following Rødseth (2008)

In the assessment of the efficiency of the agri-environmental payments to the extensive livestock sector we internalize the "market" of agricultural landscape with the use of the WTP function (as described above). The price of the public good corresponds to the household marginal WTP for it. The demand for landscape depends on household income and prices of commodities; with growing real household income, households are willing to pay more for landscape and vice versa.

In the model, landscape production competes for land with other agricultural sectors; land is converted into extensive grassland production as long as the total income from extensive production is higher than from the intensive one. Summary of the main characteristics of the model is presented in Table 3.

Table 3: Main features of the modelling approach

	Model description
Gross production of the extensive livestock sector	Represented by the gross production of the private commodity (beef) + public commodity (landscape)
Landscape supply	Modelled as a fixed share of the total gross production of sector 14
Landscape demand	Explicitly by households

3. SCENARIOS

To assess the efficiency of the agri-environmental payments and to show the capacity of the extended model scenarios have been prepared and calculated:

Scenario 1 aims at simulating the provision of permanent grassland landscape under the internalised "market" for public good and when no specific (additional) governmental support directed to the extensive livestock sector is assumed. Nevertheless, the sector still receives direct payments. This simulation is performed without further policy changes for the whole period 2007- 2020. In order to maintain the governmental balance, the removed subsidies are transferred to both types of households in the proportion of their size.

Scenario 2- models the situation of parallel existence of landscape market where households are the consumers of landscape, and the additional governmental support. The total revenue of the extensive farming sector thus consists of market revenue from the private commodity represented by beef production, the revenue from the public good market, direct payments and the additional subsidy revenue of various policy measures related to grasslands and beef production (e.g. LFA payments, Natura 2000 payments).

Scenario 3 – is aimed at illustrating changes of in the optimal landscape provision if the additional supports (except for the direct payments) are removed form 2014 and also transferred directly to both types of households.

4. RESULTS

The results are presented in terms of the landscape value, grasslands area under extensive livestock, the landscape value based on WTP and beef production figures for both the extensive and intensive farming. Furthermore, the effects on the whole agricultural sectors as well as the national economy in terms of GDP are analyzed.

4.1. The provision of agricultural landscape under different policy options

The provision of landscape under the scenarios is presented in Table 4 and Figure 2 below. The numbers relate to the area of grasslands under extensive livestock farming - absolute figures in the graph and annual growth rates in the table. In the benchmark period, the size of grasslands that were operated in the extensive livestock farming amounted 1,300 thousand hectares. The simulation of Scenario 1 shows that if the additional supports to grasslands were removed and reallocated to households in form of the financial transfers in 2007, the size of permanent grasses would shrink to 725 thousand ha, which represents a 44% decline with respect to 2006. Scenario 1 further shows, that the extent of grasslands would be gradually increasing in the following periods, which can be explained by an increasing real income of households and thus their increasing willingness to pay for the landscape. Furthermore, it can be expected that the grassland size would stabilize in the extent of 1,100 thousand ha in the end of the analyzed period.

In *Scenario 2* when the revenue from the beef and "landscape" markets is complemented with the additional government support, the amount of land employed in the extensive livestock sector growths substantially, reaching more than 1,650 thousand ha. Between 2007-2014, the grassland area increases, which is due to growing amount of supports granted by the Rural Development Programme. After 2014, the support stays at the 2013 level.

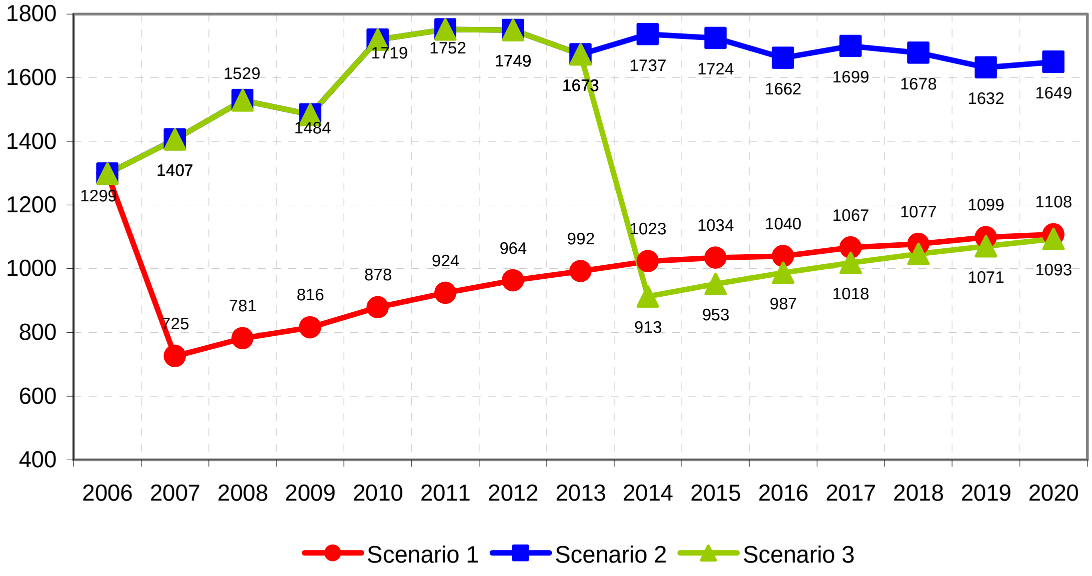
Scenario 3 provides the extent of grasslands if the additional agri-environmental subsidies are removed from 2014 and the support of the landscape provision is determined only by households' willingness to pay. As the figure shows, it is possible to expect up to 45% decline in the amount of land employed in the extensive livestock sector. The size of grasslands would fall from 1,673 thousand ha to only 913 thousand. However, in the consequent periods, the size of grasslands will slightly recover and converge to the level in Scenario 1.

Table 4: Growth rates of land employed in the extensive livestock sector

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Scenario 1	-44%	8%	4%	8%	5%	4%	3%	3%	1%	1%	3%	1%	2%	1%
Scenario 2	8%	9%	-3%	16%	2%	0%	-4%	4%	-1%	-4%	2%	-1%	-3%	1%
Scenario 3	8%	9%	-3%	16%	2%	0%	-4%	-45%	4%	4%	3%	3%	2%	2%

Source: own calculations

Figure 2. Land employed in the extensive farming sector ('000 ha)



Source: own calculations

The decline of the grassland area after 2014 in Scenario 2 can be attributed to the fact that high supports capitalise in the land price. Table 5 shows the development of the land price indexes of all scenarios. In Scenarios 1 and 3 where agri-environmental payments are removed, land prices are twice higher than the numeraire. Contrary to that, Scenario 2 report land prices more than 4 times higher than the numeraire. Such growth of land prices signalizes high pressures on the land market due to stimulated demand for land. This can have a reverse effect on the profitability of the extensive livestock sector.

Table 5: Development of the annual land price indices

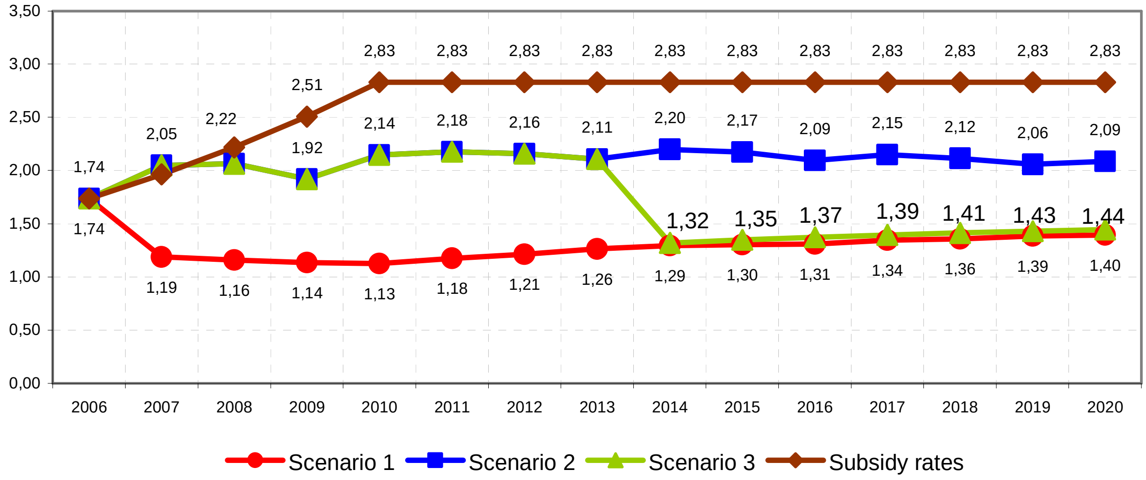
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Scenario 1	1	0.5	0.8	0.8	1.0	1.0	1.1	1.2	1.3	1.4	1.6	1.7	1.9	2.1	2.3
Scenario 2	1	1.0	1.5	1.4	2.3	2.3	2.5	2.4	2.7	2.9	2.9	3.3	3.5	3.6	4.1
Scenario 3	1	1.0	1.5	1.4	2.3	2.3	2.5	2.4	1.2	1.3	1.5	1.6	1.8	2.0	2.3

Source: own calculations

4.2. Demand for landscape and the optimal subsidy rates

In the benchmark equilibrium, the WTP for the landscape is set equal to the agri-environmental payments, reaching CZK 1.7 billion. In the following periods, the demand for landscape is determined by the LES function which depends on the households´ income and the landscape price, corresponding to the marginal willingness to pay. With growing income, the households are willing to pay more for the landscape and their demand increases. On the other hand, increasing price of landscape reduces the demand. This behaviour is also demonstrated in Figure 3.

Figure 3. Demand for landscape by households (bln. CZK)



Source: own calculations

Although the pattern is very similar to Figure 2 it is important to emphasize that here the value of landscape is presented. In Scenario 1, the removal of subsidies at the beginning of the analyzed period causes a decline of demand for landscape by 32%. In the consequent periods, the demand grows steadily and reaches around 1.4 bln CZK, which is still well bellow the initial level in 2006. The demand for landscape in Scenario 2 is considerably higher, which is caused by the subsidy affect. The subsidy effect maintains the price of landscape lower than what would be its market level and therefore stimulates the demand of households. The subsidy effect is clearly demonstrated in case of Scenario 3 where the demand for landscape falls by 37% and tends to converge with the level of Scenario 1. It can be concluded that with the absence of the additional subsidies, the willingness to pay for the landscape is considerably lower. On the other hand if the policy aims at environmental values which are at higher than then national levels (thus not recognised by domestic households) domestic households will benefit since they will get also more and cheaper landscape. It is also apparent from this analysis and figure that almost doubling supports to grasslands in the current programming period is far from the socially optimal level of landscape provision, if the provision and consumption of landscape are regarded to be in equilibrium in 2006. As we mentioned earlier, here we have to see the research and its results as a useful exercise providing better insight into the problem and by no means we can regard it as an evaluation of the current policy.

Table 6 shows that if the sector of extensive livestock is not supported by other subsidies than the price of public good (corresponding to the marginal WTP for landscape), price of landscape is considerably higher than in Scenario 2.

Table 6: Evolution of landscape price indexes

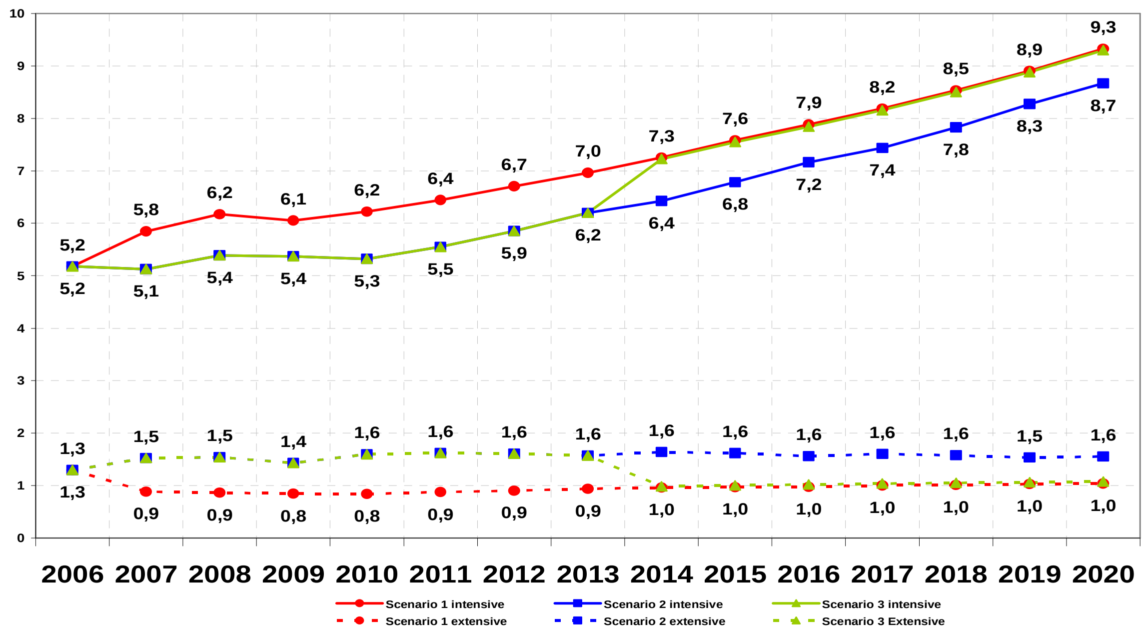
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Scenario 1	1	1.685	1.81	1.838	1.893	1.881	1.924	1.96	2.011	2.102	2.183	2.22	2.296	2.35	2.44
Scenario 2	1	0.946	0.981	1.053	0.957	0.98	1.045	1.137	1.145	1.221	1.325	1.346	1.431	1.54	1.58
Scenario 3	1	0.946	0.981	1.053	0.957	0.98	1.045	1.137	1.966	2.025	2.077	2.135	2.2	2.271	2.35

Source: own calculations

4.3. The effects on the extensive and intensive livestock production

The changes in the provision of landscape are closely related to the production of beef on grasslands, as these commodities are complements to each other in the production process. Moreover, the different policy options concerning grassland landscape have also simultaneous impact on the production of beef in the intensive livestock sector, because of the single commodity market. Figure 4 illustrates the impact of the scenarios on the production of both extensive and intensive livestock sectors.

Figure 4. Gross production of beef in extensive and intensive livestock farming (bln. CZK, constant prices of 2006))



Source: own calculations

In the benchmark equilibrium, the value of beef produced in the intensive farming is 4 times higher than in the extensive farming sector. The scenarios clearly show that this relation can be changed in favour of either farming sector, depending on the level of support to the extensive production. Concerning Scenario 1, due to the absence of the agri-environmental subsidies, the total demand for the provision of landscape declines, which is further translated to the decline of beef produced in the extensive farming. The decline in profitability of the extensive livestock sector leads to reallocation of resources to the sector of intensive livestock farming. In Scenario 2, the proportion of beef produced in the extensive farming is higher as the subsidies cover the production costs and contribute to lower the prices of beef meat. Scenario 3 converges with Scenario 1 (after 2014) and shows that the longer term size of the extensive beef production would be stabilized around 1 bln. CZK, which is 22% less than in the initial period.

4.4. The effects on total agricultural production and the GDP

The evolution of the total sector of agriculture, measured by gross value added in constant prices is presented in Table 7. In 2020, value added is expected to reach approximately CZK 80 bln, which is about 55% more than the initial level in 2006. The differences in value added between the scenarios are minimal; Scenarios 1 and 3 report slightly higher values than Scenario 2. Based on this finding it can be concluded that the scenarios that leave the agri-environmental policy determined by actual willingness to pay lead to a higher agricultural value added.

Table 7: Gross value added in agriculture (CZK bln., constant prices 2006)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Scenario 1	51.4	54.6	57.1	56.3	58.1	59.3	61.3	63.5	65.6	67.9	69.9	72.0	74.3	76.7	79.2
Scenario 2	51.4	54.6	57.0	56.2	57.7	59.0	60.9	63.1	65.1	67.3	69.4	71.4	73.6	76.0	78.5
Scenario 3	51.4	54.6	57.0	56.2	57.7	59.0	60.9	63.1	65.9	68.1	70.1	72.2	74.4	76.8	79.3

Source: own calculation

The CGE model also enables to analyse the effects of considered scenarios on GDP and its components. However, as Table 8 reports, the average growth rates of the GDP are in all scenarios almost similar. Obviously, the agri-environmental policy is too small to have any effect on macroeconomic aggregates.

Table 8: GDP components (% increase against 2006)

	GDP	Consumption	Government	Investment	Net Exports
Scenario 1	4.45%	4.45%	2.96%	5.11%	7.05%
Scenario 2	4.46%	4.45%	2.97%	5.16%	6.99%
Scenario 3	4.46%	4.46%	2.97%	5.13%	7.05%

Source: own calculation

5. CONCLUSIONS

Although the research suffered lack of credible information on the willingness of households to pay for the provision of landscape from extensive livestock production, it proved that incorporating public goods in the CGE model has important capacity to improve insight in the analysis of agri-environmental policy. If we are able to estimate or calibrate marginal WTP function we will also be able to value the non-commodity production of agriculture. It was also shown that such an extended model can provide a rich analysis of interlinks between commodity and non-commodity production and policies.

Beside the necessary improvement on the WTP surveys as an input to modelling, there are at least two other directions how to improve the analysis: the first is straightforward - by including more than one sector of multifunctional activities. The other improvement will be using the similar approach to split the beef markets and to internalise some of the environmental attributes of the production in the value of the commodity (bio-beef).

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